the student who desires to attain a clear, logical view of the foundations of algebraical science. The remaining sections demand less comment as presenting less novelty of treatment.

The most noticeable feature in the section on equations is the introduction of the notation, and a discussion of some of the properties, of determinants. We cannot but regret the space that is devoted in this section to the discussion of the processes for the extraction of square and cube roots in the old traditional shape. In the chapter on division the law of formation of the quotient and remainder of a rational integral function of x after division by $x-a$ has been established. Starting from this, a discussion involving nothing more than elementary considerations would lead up to Horner's process in all its generality, which might then be exemplified in the extraction, not only of square and cube roots, but of roots of any degree, both for algebraical expressions and for numbers. How long shall we have to wait for a due recognition in elementary treatises of this comprehensive method, which, whether from a theoretical or from a practical point of view, is one of the most valuable results of a study of algebra?

The section on series commences with the establishment of the usual formulæ for permutations and combinations, as preliminary to the binomial theorem. We observe with satisfaction that the path to the proof of each general formula is smoothed by the prior discussion of a particular case, by which, as every good teacher knows, the principle involved may be more distinctly brought out than in the general proof, where it is too likely to be lost sight of in the generality of the symbols employed. To the chapter on geometrical progression is attached, as we think it always should be, one of its most important applications—namely, that to compound interest and annuities. The chapters on the binomial theorem and other series usually discussed in elementary algebra are clear and satisfactory, though we think a little more prominence should have been given to the distinction of *convergent* and *divergent* series, and a fuller discussion of the tests of convergency and divergency.

The last section includes under the general heading of "Arithmetical Applications," chapters on proportion, continued fractions, indeterminate equations (limited to those of the first degree), inequalities, notation and numbers, and probabilities. It is not intended, we presume, that the study of some at least of these should be postponed till after the study of the previous sections, but that as *Applications* they do not form a necessary part of the general sequence of algebraical results, though it appears to us rather strange that a place for proportion, at any rate, should not have been found in such sequence.

R. B. H.

PRACTICAL BOTANY.

Practical Botany. By F. O. Bower and Sydney H. Vines. Part II. (London: Macmillan and Co., 1887.)

ABOUT twelve or fourteen years ago there occurred in England two events which have had so marked an influence on the development of scientific botany in this country that they are likely never to be lost sight of by our younger school of morphologists and physiologists. One of these events was the introduction into this country of the teaching of Prof. Sachs, of Würzburg; the second and even more important one was the institution by Mr. Thiselton Dyer of a course of botanical instruction at South Kensington on a scale never before attempted. Those who had the good fortune to attend Mr. Dyer's courses of practical botany in the well-known laboratory at what is now the Normal School of Science must always carry with them the stimulating remembrance of the thorough teaching there instituted; and the effect of the exact instruction and inspiriting demonstration so efficient at South Kensington can be obviously traced in the excellent teaching and work of the enthusiastic younger botanists of to-day. The influence took effect on the early development of the present productive botanical laboratories at Cambridge and elsewhere, and the stimulus has since radiated thence in all directions, as is shown not only by the numerous publications of the last eight or ten years, but also by contributions to the new journal, *The Annals of Botany*, just published by the Oxford Clarendon Press, and by the activity and discussions of the botanists at the recent brilliant meeting of the British Association in Manchester.

The salient features of the new course of structural botany were the thorough study of leading types of the vegetable kingdom by means of material dissected and prepared by the students themselves, and the stress laid on the rule that the students should carefully draw what they saw, and thus gather their ideas at first hand. The method was similar to that employed by Prof. Huxley in his course on animal morphology.

It is evident that the little hand-book of practical botany now under review is the outcome of experience gained in continuing this important method of instruction. Part I. of the present work was published two years ago, and dealt with selected types of the Vascular plants. Part II. is now before us, and completes the scheme. It comprises studies of the chief types of lower Cryptogams, from the moss downwards.

We have already pointed out that the essential features of the new teaching are the exact and thorough study of types. Nothing is assumed; but the students are urged to see everything for themselves, and to draw all they see. These important points decide the plan of the work under review. It will be found an excellent and trustworthy guide to any who use it with the types at hand: it will be all but useless to the mere crammer, for there are no illustrations to take the place of actual objects in producing impressions on the student's mind; no lengthy descriptions to interfere with the directness or clearness of the impressions; and no classified "tips" to vitiate and confuse the teaching. We regard it as an excellent sign of the progress of botany in this country that an English work of this description should be forthcoming, and students are greatly indebted to Dr. Vines and Dr. Bower, and those who have contributed to this admirable little monument of practical teaching.

As special features in the book we may commend the selection of types; they are good, for the most part easily obtained, and well known. The treatment of the types in the book is clear, concise, and yet sufficient. The usage of bolder lettering for the chief word in the paragraph is an admirable device for fixing the student's attention on one thing at a time, and is aided by the numbering and lettering of the paragraphs. The division into sections dealing with groups of characters, leading the student on from the more obvious features to those less easily investigated, also stamps the work as that of experienced teachers, and is eminently English.

The only part of the plan to which objection is likely to be raised by teachers is what may perhaps be termed the reversal of the order of the types. We are ourselves inclined to the opinion that it would have been better to begin with the more lowly organized types, and work upwards to those in which the anatomy and histology become more complex. There is much to be said in favour of the method adopted, but we think that the following two objections to it alone outweigh all we have heard in its favour.

(1) The types are obviously selected as illustrating the chief structural peculiarities of plants, and it might be better to at least indicate the relations of these structures in an order more in accordance with their probable development in the vegetable kingdom.

(2) The plan of teaching which marks the book is the educational one, *i.e.* the observer is led on from simple to less simple ideas. This is only carried out consistently, however, within the individual sections of the book: why should it not be followed throughout the work?

Of course the objection may be anticipated that the sections really lead the student on from the macroscopic to the microscopic characters, and that Algæ and Fungi, for instance, are less easy to investigate, and therefore come last, because they involve the use of the higher powers of the microscope so much. We do not admit that this latter is a difficulty, however, and in reply would simply propose for psychological study the mental attitude of a tyro struggling with his first transverse section of a sunflower-stem. The cutting, preparation, mounting, and finally the involved pattern of cell-walls which he has to unravel, at once plunge him into difficulties at least as great as those met with on the threshold of the study of the Algæ. Moreover, there is evidence in the work that the student is supposed to be acquainted with the use of the microscope, such as would be obtained from a proper course of elementary biology.

Of course, however, it is always open to a teacher to reverse the order of the types in the book; and it only remains for us to say a few words regarding some of those employed in the second volume. *Polytrichum* is selected as the chief type of the mosses, and we think Dr. Bower has done well to illustrate the details of structure by this complex form, surmounting the difficulty presented by its peculiar sporogonium by a comparative study of that of *Funaria*—itself an excellent type. We are glad to see *Marchantia* treated in detail. It is, of course, an out-of-the-way form, and is peculiar even in its own group, but it is an instructive plant, and one that has earned a reputation from the physiological lessons it teaches us. *Polysiphonia* serves as the chief type of the red sea-weeds, and although it has many peculiarities, it has the advantage of being common: the structures of several other Florideæ are shortly compared with that of *Polysiphonia*. *Fucus serratus* forms an excellent type for the study of the brown sea-weeds, and as it is easily obtained, it should be employed in every laboratory course: the details of the actual process of fertilization still offer an interesting problem to any intelligent student, but the chief stages in the process are not difficult to observe.

Passing to the green Algæ, *Œdogonium* seems to us a type well worth thorough study in the laboratory; it is by no means uncommon, and an effort should be made to introduce a definite species of the larger forms as a type. Short studies of *Coleochæte* and of *Ulothrix* are also given. *Vaucheria sessilis* is offered as an example of the Siphoneæ, and we are glad to see it brought well into the foreground; this again is a plant of increasing importance as an instructive plant. Most of the details of the process of fertilization in this Alga offer less difficulties than is commonly supposed, and students should be encouraged to spend some time on their study. A short *résumé* of the main points is given. No doubt the presence of *Protococcus* or *Hæmatococcus* in schedules of elementary biology explains its omission from the present work: *Pleurococcus* and *Volvox* are given, however, and they illustrate several points of importance. In spite of—or perhaps on account of—its very marked peculiarities, we look upon *Spirogyra* as one of the most instructive types that the student can examine, and Dr. Bower has done well to give it a prominent position. It deserves more attention, however, and we would strongly urge an exhaustive treatment of its life-history, germination, and some of the physiological lessons it teaches.

Passing over less important forms, we may now say a few words respecting the Fungi given as types for study. The first section is devoted to *Agaricus*, and a capital study of the structure and histology of the common mushroom is given. Then follows an equally good account of the Æcidiomycetes. Of Ascomycetes, we have *Peziza*, *Parmelia*, *Claviceps*, and *Eurotium*, as types of the chief great groups. A word as to *Peziza*. It is an excellent type, and certain forms can be cultivated, and we hope that in a second edition the author will see his way to introducing a fuller account of some one species. At the same time we are not sure that *Ascobolus* is not a better form for the present purpose: it can be easily cultivated, and its small size is an advantage, since perfect sections can be obtained across the whole plant. Another excellent type is also introduced in the study of the Peronosporeæ. English students are only now becoming aware of the theoretical importance of this group, and we are very glad to see Dr. Bower's section on *Pythium de Baryanum*: it cannot be too well understood that *Pythium* is one of the few parasitic Fungi which may be easily cultivated and followed through all its phases of development in the laboratory. For our own part, we regard it as the best of all Fungi for study, and its life-history and simple structure ought to be thoroughly investigated in every botanical course. It has the additional advantage of being also a saprophyte, and can be cultivated on dead organisms. The Mucorineæ are exemplified by *Mucor* and *Sporodinia*. No type of the Ustilagineæ is given.

Enough has been said to show that the volume pretends to no more than it can fairly claim, and we regard it with confidence as a praiseworthy and successful attempt to record for the benefit of a wide class of students the methods of teaching so well introduced and so thoroughly carried out in the laboratory at South Kensington, the birth-place of the modern English school of morphological botany. It now remains for one of our competent younger botanists to prepare a course of practical instruction in the physiology of plants, introducing the experiments employed in our best laboratories; and there are signs that such a volume will meet with a hearty welcome from students of botany in this country. The importance of the subject needs no comment.

OUR BOOK SHELF.

A Chapter in the History of Meteorites. By the late Walter Flight, D.Sc., F.R.S. (London: Dulau and Co., 1887.)

THIS work, though left incomplete by the early death of its author, will be found of great service by all who are interested in meteoric studies. The first 144 pages were printed off twelve years ago, and were thus safely beyond revision. The rest of the work has been revised, and the whole has been prepared for press, by editors who, perhaps wisely, have chosen to be anonymous: their part of the task we may dismiss with the remark that it appears to have been executed with at least ordinary care. The task of the author has been to give a brief summary of the memoirs which have been published relative to meteorites since the year 1868, and thus to furnish an appendix to the work of Buchner. To collectors of meteorites such a convenient summary of memoirs, themselves scattered over a wide range of periodicals, chiefly foreign, is invaluable. There are seven plates and six woodcuts: the frontispiece is an excellent engraving of Chladni, who did so much to compel men of science to recognize the reality of meteoric falls. There is also a hand-painted picture of the wonderful meteorite of Busti, in which two minerals new to terrestrial mineralogy were discovered by Maskelyne. In an introduction there is a short sketch of the life and work of the author. Only 240 copies have been printed; the proceeds of their sale are to be added to the Flight Memorial Fund, which at present amounts to £317.

A Hand-book for Steam Users. By M. Powis Bale, M.I.M.E., A.M.I.C.E. (London: Longmans, 1887.)

MR. BALE'S little hand book supplies a want long felt by steam users. Its contents are entirely of a practical nature, and the technical terms used are very properly those of the ordinary mechanic. The book embraces the whole of the many duties of the engine-driver and fireman, and explains to them what to do, and what not to do, under varying circumstances. The arrangement of the information is simple and effective, the writer evidently knowing how to get at the understanding of those for whom the book is written.

The information and rules given are eminently practical, and will prove very useful to those steam users who do not pretend to be engineers. In the preface we are told that the author has for many years urged the necessity of a compulsory system of boiler inspection, and of granting certificates of competency to those having boilers under their charge. In this we entirely agree, and we trust the time is not far distant when Parliament will establish a system of examination similar to that of marine engineers, under the control of the Board of Trade for all who have charge of stationary boilers and engines, as well as locomotives. Michael Reynolds, the author of several books on the practical working of steam-engines, has long advocated the introduction of certificates of competency for locomotive drivers and firemen. Their duties are as arduous and responsible as those of the marine engineer, and yet this fine class of men is entirely recruited from the lower grades employed in the locomotive running sheds and works, and their promotion generally depends on years of service on the footplate.

Students of steam and mechanical engineering will here find information which, although not generally taught in the lecture-rooms, will indicate some of the many points an ordinary engine-driver has to be thoroughly acquainted with.

N. J. L.

The Encyclopædic Dictionary. Vol. VI. (Part II.) (London: Cassell and Co., 1887.)

THE special characteristic of this work is that the compilers have tried to make it combine some of the advantages of an encyclopædia with all the advantages of a dictionary. The result, upon the whole, is very satisfactory. The information given in the encyclopædic part of the work is not, of course, sufficient for students; but it will meet the wants of readers who may wish to obtain a concise and trustworthy account of any subject in which they happen to be interested. Special attention is devoted to the various branches of science, and scientific terms are very carefully defined and explained. So far as we have been able to test the volume of which this is the second part, we have found it in all respects equal to the preceding volumes.

A Treatise on the Principle of Sufficient Reason: a Psychological Theory of Reasoning, showing the Relativity of Thought to the Thinker, of Recognition to Cognition, the Identity of Presentation and Representation, of Perception and Apperception. By Mrs. P. F. Fitzgerald. (London: Thomas Laurie, 1887.)

THIS is neither a treatise nor has it anything particularly to do with the principle of the sufficient reason, or with the philosophical views mentioned in the second title. It is rather a kaleidoscope of phrases, original and otherwise, that have apparently from time to time touched the author's fancy, and are now vaguely but gratefully remembered to have once possessed a meaning for her. Quotations from Ouida, Plato, Lord Dundreary, and other philosophical authorities, are tossed together impartially, without apparent purpose except to fill 400 pages; and though some reference is made occasionally to opinions said to be held by the author, such reference is nearly always too vague to show what the opinions really are. Only the hard-hearted can find even amusement in the book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

"Infusorial Earth."

THE following letter, addressed to the Secretary of the Royal Society, has been forwarded to us for publication:—

Foreign Office, October 27, 1887.

SIR,—I am directed by the Marquess of Salisbury to state to you, for the information of the President and Fellows of the